

Experiments and Modeling with a Large-Area Inductively Coupled Plasma (ICP) Source

R.D. Benjamin, G. Dipeso, P.O. Egan , G.J. Parker, R.A. Richardson and P. Vitello
Lawrence Livermore National Laboratory

We describe initial experiments with a large (30") plasma source chamber to explore the problems associated with large-area inductively coupled plasma (ICP) sources to produce high density plasmas useful for processing 400 mm semiconductor wafers. Our experiments typically use a 25" diameter planar ICP coil driven at 13.56 MHz. Plasma and system data are taken in Ar and N₂ over the pressure range 3-50 mtorr. R.F. inductive power was run up to 2000W, but typically data were taken over the range 100-1000W. Diagnostics include optical emission spectroscopy, Langmuir probes, and B-dot probes as well as electrical circuit measurements. The B-dot and E-M measurements are compared with models based on commercial E-M codes. Initial indications are that uniform plasmas suitable for 400 mm processing are attainable.

We present a comparison between computer modeling and experimental results for this source. Computer simulations using the fluid code INDUCT94 are used to explain variations in the plasma density profile measurements as a function of inductive power gas pressure and gas composition. Both Argon and Nitrogen discharges are modeled. INDUCT94 solves the 2D time-dependent fluid equations for electrons, ions and neutrals including effects of both inductive and capacitive coupling. Detailed volume and surface chemistry reactions are treated. We discuss the effects of pressure and power on plasma uniformity.

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